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BROADCAST APPLICATIONS OF HERBICIDES TO CONTROL SCRUB OAK REGROWTH

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Abstract: Three annual broadcast applications of brushkiller (a 50-50 mixture of low volatile esters of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid) at concentrations of 4 and 8 lbs. acid equivalent per acre in 20 gals. of water and the isooctyl ester of 2,4-D at 8 lbs. a.e. per acre killed 90 to 100 percent of the sprouting scrub oak *(Quercus dumosa* Nutt.*)* plants. Picloram (Tordon 22 K) alone or a mixture of picloram and 2,4-D (Tordon 101) killed 61 percent or less at concentrations up to 6 lbs. a.e. per acre. Effectiveness of treatment appeared to be related to plant height, but not to plant diameter or volume except for small (less than 12 inches tall) or large (more than 30 inches tall) plants.

Oxford: 176.2 *Quercus dumosa;* 441–414.22.
Retrieval Terms: Quercus dumosa; herbicide trials; broadcast spraying; 2,4-D; 2,4,5-T; picloram.

Controlling regrowth of scrub oak *(Quercus dumosa* Nutt.*)* on brush conversion sites in California is a difficult job. At least three annual foliage applications of phenoxy herbicides are required to kill most of the plants. Although individual plant spraying is generally recommended for the second or third application or both, limited studies suggest that three broadcast applications may give the same amount of plant kill.[1] In an earlier study[2] I found that individual plant application of picloram (Tordon 22 K)[3] was more effective than brushkiller (a 50-50 mixture of low volatile esters of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid).[4]

In a follow-up to the earlier study, trials to control scrub oak regrowth were set up on the Cleveland National Forest, in southern California. Three annual broadcast applications were tested, and the effectiveness of two concentrations of four herbicide formulations were compared. The three applications of either 4 lbs. a.e. of brushkiller or 8 lbs. a.e. of isooctyl ester of 2,4-D gave almost total control of sprouting plants. The results provide a guide to conditions for predicting kills which might be obtained with 2,4-D or brushkiller.

METHODS

The original brush cover of the test plots, composed predominantely of scrub oak, had been removed by hand clearing 3 years earlier. The sprout growth was recut in spring before the first spray application in late July and early August 1965. Regrowth then was 1 to 2 feet tall, and a flush of succulent new growth 1 to 6 inches long had developed from the leaf axils of the somewhat older sprouts. A single sample of sprout moisture content determined by xylene distillation, was 185 percent for succulent material, and 174 percent for the older sprouts. The plots were resprayed in August 1966 and 1967.

The four herbicidal formulations tested were applied at two concentrations in a total volume of 20 gallons per acre:

Herbicide:	*Rate*	*Acid equivalent per acre*
2,4-D (isooctyl ester)	1	4 lbs.
	2	8 lbs.
Brushkiller (1:1 low volatile ester 2,4-D and 2,4,5-T)	1	4 lbs.
	2	8 lbs.
Picloram (Tordon 22 K, potassium salt)	1	3 lbs.
	2	6 lbs.
Picloram (Tordon 101, tri-isopropanolamine salts)	1	2 lbs. 2,4-D; 3/4 lb. picloram
	2	4 lbs. 2,4-D; 1½ lbs. picloram

Spraying was done with a portable boom *(fig. 1)* outfitted with six No. 80015 Teejet nozzles, which covered a 10-foot-wide swath. The test plots were 30 feet wide (three swaths) and 100 feet long. The treatments were replicated twice in a randomized block design. Results were determined 12 months after treatment, just before respraying, by recording the condition of all plants in an 8.7-foot-wide strip down the center of the middle swath. At the time of initial sampling, the height and average diameter of each clump of sprouts were recorded.

RESULTS

First Application

A total of 261 scrub oak plants were sampled (stand density was about 700 plants/acre) in August 1966, 1 year after the first application. Of these, only six plants were recorded as apparently dead. The rest of the plants had lost all of their leaves, and the sprout tips were killed. Stem sprouting had occurred on most of the plants, and crown regrowth was 1 to 2½ feet tall. No obvious differences in woody plant response to the different treatments were found. The results are similar to those reported for a test of individual plant spraying held on an adjacent area.[2]

Ceanothus seedlings and broadleaved herbaceous plants present at the time of spraying had disappeared. Annual grasses had increased.

Second Application

On the basis of percent of plants apparently dead, the best kill after the second application was with brushkiller. And the poorest kill was with picloram alone or in combination with 2,4-D. The 38 percent plant kill obtained with 4 lbs. a.e. of brushkiller—the concentration normally recommended for shrub con-

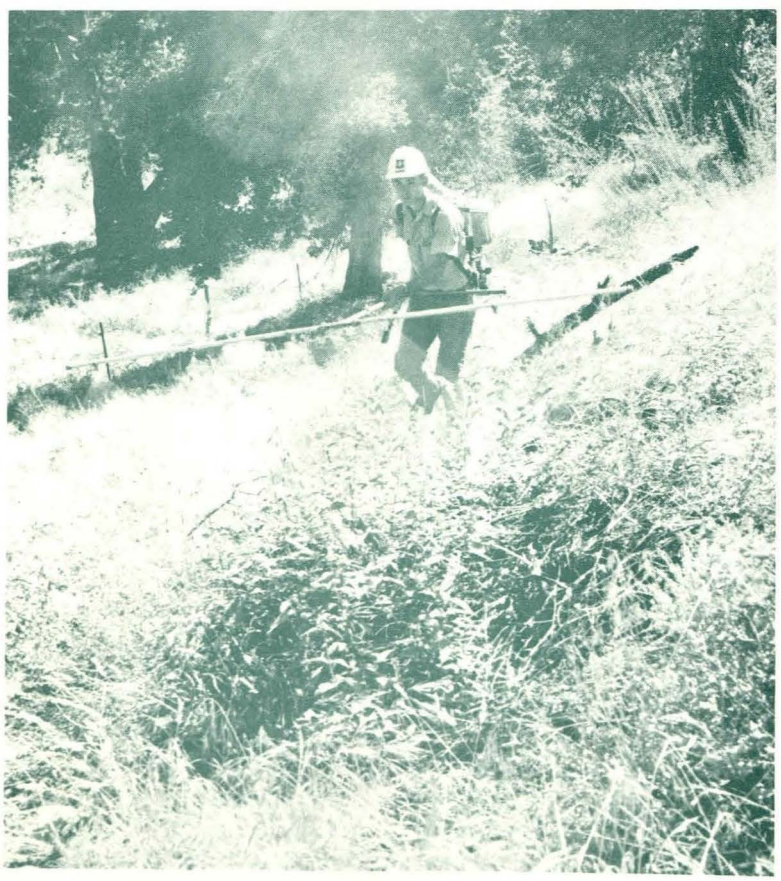

Figure 1—*Herbicide was applied to scrub oak regrowth with a portable spray boom. Effective swath width is 10 feet.*

trol—was comparable to the 35 percent average oak kill previously reported for two successive spray applications.[1]

The poor plant kill obtained with the Tordon formulations was unexpected, since it had been found to be two to four times more effective than brushkiller in the individual plant treatment test.[3] These results may be explained on the basis of dosage to the crown of the scrub oak not being adequate from broadcast applications, but adequate when the plants were thoroughly wet with an individual plant treatment.

Third Application

The same comparative results obtained with the different herbicides after two applications were also maintained after the third application *(table 1).* However, excellent kill had now been obtained with both rates of brushkiller and the 8 lb. rate of 2,4-D. On the basis of average percent of dead plants obtained by pooling the two concentrations of each herbicide, the results from brushkiller were significantly different (at the 5 percent level) from those of the two Tordon formulations. The results from applying isooctyl ester of 2,4-D were not significantly different from results using either brushkiller or Tordon.

Table 1—*Dead scrub oak plants after two or three annual broadcast herbicide applications, by formulation, Cleveland National Forest, California*

Herbicide formulation	Lbs. a.e. per acre	Percent dead plants		
		Second application	Third application	Mean for third application[1]
2,4-D (isooctyl ester)	4	11	64	79 ab
	8	25	94	
Brushkiller (1:1 low volatile esters 2,4,-D and 2,4,5-T)	4	38	91	96 a
	8	46	100	
Picloram (Tordon 22 K, potassium salt)	3	17	61	54 b
	6	3	47	
Picloram (Tordon 101, tri-isopropanolamine salts)	([2])	17	41	43 b
	([3])	3	46	

[1]Based on an analysis of variance. Values followed by the same letter do not differ significantly at the 5 percent level, according to Duncan's Multiple Range Test.
[2]2,4-D, 2 lbs. and picloram, ¾ lb.
[3]2,4-D, 4 lbs. and picloram 1½ lbs.

DISCUSSION

Personal observations and reports from various field personnel on regular spray projects suggest that much less control has often been obtained with three or more annual broadcast applications of 4 to 6 lbs. a.e. of brushkiller than was obtained in this test.

The better plant kills obtained in this test can be explained at least in part, on the basis of (a) better plant coverage than is obtained in routine spray applications—especially aerial applications; (b) moderate size of the regrowth when sprayed; and (c) active but nonvigorous shoot growth at the time of spraying. If the soil moisture had been lower because the shrub plants were larger or because of a dense stand of grass, high rates of kill from spraying in August could hardly have been expected.[5] A physiologically active plant requires adequate water from some source.

The results of this study provide a guide to conditions that should be sought for predicting kills which might be obtained with 2,4-D or brushkiller. Such guides are needed to enlarge on recommendations for spraying 1 to 3 months later than had been previously suggested.[6,7] It is the physiological condition of the plant rather than the date that determines when it is most susceptible.[7] These conditions would seem to be (a) small shoots with healthy leaves, (b) sufficient soil water for at least slow growth, and (c) sufficient time lapse after top removal for dormant buds to have developed shoots.

The reason for the reduced effectiveness of picloram is not clear—especially when compared to the good results obtained with the individual plant treatments reported earlier.[2] Poor results from summer application of picloram on chaparral, however, have been a common experience in California.[5] Furthermore, although picloram has been superior to 2,4-D when applied in cuts in oak stems and when individual plants were hand sprayed, it has been poorer than 2,4-D in foliage trials reported by Leonard.[8]

The plants were originally tallied on the basis of the height and diameter of the regrowth, and the relative plant volumes could be calculated. Therefore, I tried to determine the influence, if any, plant size had on herbicide effect. Pooled data on the percent of plant kill for all herbicides and for the picloram formulations alone were plotted *(fig. 2).* Excluding the extreme size classes in which fewer than 13 plants were recorded, I found no obvious consistent relationship between plant volume or plant diameter and

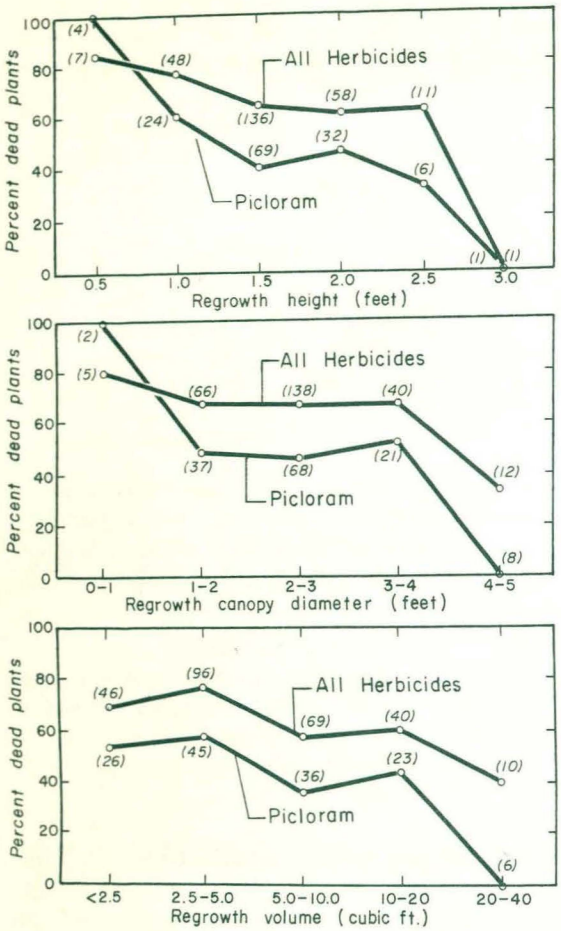

Figure 2–*The relationship between regrowth height, diameter, and volume and the percent of scrub oak plants killed from three annual broadcast herbicide applications. Figures next to each plotted point show the number of plants in each size-category.*

plant kill. However, extremely small (less than 12 inches tall) and extremely large (more than 30 inches tall) plants tended to show greater and lesser effect respectively. The taller plants appeared to be slightly more difficult to kill. Earlier work indicated that regrowth more than 2½ to 3 feet tall should be recut before treatment.[7] In this earlier work, it was assumed, in part, that there would be less herbicide spray coverage in the center of large plants than in the center of small ones. However, the number of sprouts or density of regrowth is more important than height alone, if factors other than spray coverage *per se* are not involved.

Proper evaluation of the relationship between plant size and response to herbicide treatment would require a test specifically designed for that purpose. On the other hand, in tests where plant size is not a variable, extremely small and extremely large plants should be omitted.

NOTES

[1]Plumb, T. R. *Brushkiller to control scrub oak sprouts–combinations of broadcast and individual plant applications tested.* U.S. Forest Serv. Res. Note PSW-146, Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 6 p. 1967.

[2]Plumb, Timothy R. *Control of brush regrowth in southern California with Tordon and phenoxy herbicides.* Down to Earth 24(3): 19-22. 1968.

[3]Tordon 22 K is the commercial name of the Dow Chemical Company for the potassium salt of picloram (4-amino-3,5,6-trichloropicolinic acid). Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by U.S. Department of Agriculture is implied.

[4] Butoxy ethanol ester of 2,4-dichlorophenoxyacetic acid and propylene glycol butyl ether ester of 2,4,5-trichlorophenoxyacetic acid.

[5]Personal correspondence with O. A. Leonard, University of California, Davis, May 17, 1971.

[6]Leonard, O. A., and W. A. Harvey. *Chemical control of woody plants.* Calif. Agr. Exp. Sta. Bull. 813. 26 p. 1965.

[7]Plumb, T. R., J. R. Bentley, and V. E. White. *Chemical control of brush regrowth on fuel-breaks.* U.S. Forest Serv., Pacific SW. Forest & Range Exp. Sta., Fuel-Break Rep. 11. 41 p. 1963.

[8]Leonard O. A. *Preliminary results with Tordon for woody plant control.* Proc. 16th Annu. Calif. Weed Conf. 1964: 101-103. 1964.

The Author

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